

TWO NEW SUBSPECIES WITHIN *EUCALYPTUS LEUCOXYLON* F. MUELL. AND NOTES ON THAT SPECIES

by

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ABSTRACT

Rule, K. Two new subspecies within *Eucalyptus leucoxylon* F. Muell. and notes on that species. *Muelleria* 7(3): 389–403 (1991). — Two new taxa within *Eucalyptus leucoxylon* F. Muell. are described, viz. ssp. *stephaniae* K. Rule, whose populations are sporadic over the sandy tracts of Upper South-east South Australia and the Wimmera region of Western Victoria, and ssp. *connata* K. Rule, whose markedly depleted populations occur in the vicinity of Melbourne and Geelong. The complex nature of *E. leucoxylon* is discussed, including aspects of its variable morphology and how they relate to its infraspecific taxonomy.

INTRODUCTION

In 1855 Baron von Mueller described *E. leucoxylon* from a specimen collected in the Mt Lofty Ranges to the north-east of Adelaide in an area referred to as the “Devil’s Country”. The original concept of var. *pruinosa* F. Muell. ex Miq. came in the following year and was based on a collection made by Behr at Salt Creek presumed to be in the neighboring Barossa Valley. In 1883 the var. *pauperita* Brown was named to accommodate populations of mallees and stunted trees occurring in drier areas such as the Southern Flinders Ranges. Also described in 1883 was the var. *macrocarpa* Brown. Several other varieties, including var. *rugulosa* F. Muell. ex Miq., var. *rostellata* F. Muell. ex Miq., var. *erythrostema* F. Muell. ex Miq. and var. *angulata* Benth. were erected but did not endure as viable taxa.

Boland and Brooker (1974) completed the first worthwhile survey of *E. leucoxylon* and drew attention to its polymorphic nature. Subsequently, Boland (1978) completed his geographic study of the species and in a second paper (1979) erected four formal subspecies to accommodate the morphological forms he had observed. *E. leucoxylon* ssp. *leucoxylon* Boland replaced var. *leucoxylon* (and others) and included numerous South Australian and Victorian subcoastal populations with medium-sized fruits and non-waxy seedlings. The horticulturally exploited var. *macrocarpa* was replaced by ssp. *megalocarpa* Boland to accommodate non-waxy, large-fruited, large-leaved coastal populations on Kangaroo Island and sites in the Mt Gambier area. Also derived from var. *macrocarpa* was ssp. *petiolaris* Boland which consisted of populations on the Eyre Peninsula and which featured large, ribbed, often campanulate fruits and petiolate, alternate juvenile leaves. The fourth taxon, previously referred to as var. *pruinosa* and var. *pauperita*, was ssp. *pruinosa* Boland which included inland populations from the Southern Flinders Ranges to Central Victoria, its main features being small fruits and adult leaves and waxy juvenile leaves.

Despite Boland’s pioneering attempt to bring order to *E. leucoxylon*, there is evidence that his work with the species was incomplete. In fact, two additional forms, each being morphologically distinct and occupying its own discrete habitat and geographical range, have been identified using both field studies and seedling trials. The focus of this paper is on a small-fruited, non-waxy form, whose sporadic populations occur across the extensive sandy tracts of South Australia’s Upper South-east and adjacent regions of Western Victoria, and on a second

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Fig. 1. *Eucalyptus leucoxylon* ssp. *stephaniae*. a-b — buds, fruits and adult leaves $\times 1$ (drawn from type specimen). c — fruit showing pellicle $\times 2$ (drawn from type specimen). d — juvenile leaves $\times 1$ (from type population).

form, also relatively small-fruited and non-waxy, which occurs on sandstone hills in the vicinities of Melbourne and Geelong.

TAXONOMY

Eucalyptus leucoxylo F. Muell. ssp. *stephaniae* K. Rule ssp. nov.

Frutex (mallee) vel arbor parva foliis juvenilibus non glaucis non connatis, adultis ad 12.5 × 2 cm, et fructibus relative parvis plerumque hemisphaericis breviter pedicellatis pellicula membranacea tegenti orificium. A subspecie typica foliis juvenilibus adultisque parvioribus et fructibus non elongatis in pedicellis brevioribus pellicula persistenti differt.

HOLOTYPE: 9.6 km N of Yanac by road towards Murrayville, 36°05' S, 141°22' E, 15.v.1985, K. Rule (MEL 1527410).

Small mallees to small trees to 15 m. *Foliage* usually semi-weeping. *Bark* pale, sometimes mottled, usually smooth to the ground in mallees or with a short stocking of dark brown fibrous bark at the base in trees. *Seedling leaves* subsessile, ovate-elliptical, decussate for 3 to 5 pairs, blue-green, discolorous. *Juvenile leaves* sessile, opposite, lanceolate to broad-lanceolate or rarely ovate, blue-green, becoming colorous, non-waxy, non-connate, with bases rounded or rarely slightly cordate, never amplexicaul, to 6.5 × 3.5 cm. *Intranodal extensions* developing at nine to fifteen pairs. *Intermediate leaves* petiolate, alternate, green, lanceolate. *Adult leaves* petiolate, slightly glossy, olive-green to green, lanceolate, to 12.5 × 2 cm. *Buds* 3 (-7), globular to slightly ovoid, yellow, non-waxy. *Ovular rows* 4. *Operculum* obtuse-conical to shortly rostrate, to 7 × 6 mm. *Pedicels* approximately the same length as the buds. *Fruits* non-ribbed, hemispherical or slightly globular-truncate, strikingly burnished, to 8 × 11 mm, always wider than long. *Valves* enclosed to 2 mm below the rim. *Membranous pellicle* regularly persisting over the fruit's orifice. *Locules* 6 (-7). *Pedicels* always shorter than fruit length. *Peduncles* to 8 mm long. (Figure 1)

SPECIMENS EXAMINED:

South Australia — Emu Flat, Sterling Range, 3 miles NE of Keith, 14.vii.1952, R. Melville 429 (MEL); Ashville, 20 km N of Meningie, 35°31' S, 139°32' E, 22.xi.1959, P.G. Wilson 1434, (AD 96022106); 4 miles S of Salt Creek, 35°34' S, 138°55' E, 21.x.1961, J.H. Willis (MEL); 17.4 km NW of Padthaway towards Keith, 36°30' S, 140°18' E, 17.vii.1975, G. Chippendale GC1328 (MEL); 10 km N Coomandook, 35°28' S, 139°42' E, 29.ix.1976, C.D. Boomsma (MEL 538686); Box Flat, 34 km SSW of Lameroo, 9.x.1977, J.G. West 2445 (AD 97811178); Comet Bore, approx. 90 km N of Bordertown (Hundred of Fisk), 35°40' S, 140°50' E, 27.xi.1978, C.D. Boomsma 460 (MEL 593629); Adjacent to the entrance of the Jip Jip Conservation Park, 36°31' S, 140°25' E, 20.v.1985, K. Rule (MEL).

Victoria — 12 miles E of Kaniva, 36°25' E, 141°29' S, 21.ix.1952, 21.ix.1952, R. Melville 11872 (MEL); Little Desert, S of Miram South, 3.xi.1975, M. G. Corrick 5360 (MEL 593629); NW Wyperfeld, 35°52' S, 141°58' E, 27.vii.1961 J.H. Willis (MEL); Red Bluff, 4.xi.1984, D. Albrecht (MEL); 5 km N of Jeparit, 36°05' S, 141°59' E, 2.ix.1986, K. Rule (MEL); 30 km W of Rainbow and 5 km S of Chinaman Flat, 35°54' S, 141°00' E, 9.x.1979, G.C. Cornwall 333 (MEL 598454); 17.7 km S of Murrayville-Pinaroo Rd on track to soak (3 km W of Murrayville), 35°25' S, 141°07' E, 5.ix.1989, M.I.H. Brooker 10270 (MEL 118383).

DISTRIBUTION (Figure 2):

The distribution of *E. leucoxylo* ssp. *stephaniae* is extensive but sporadic on shallow sands in the desert country of South Australia's Upper South-east and Victoria's Wimmera, from Meningie in the west to Dimboola in the east. Whilst its southern limits are defined by the southern margins of the Victorian Little Desert and similar areas of the same latitude in South Australia, the exact extent of its northern extremity is uncertain. The northern-most herbarium collections suggest it approximates the latitude of 35°25' S.

ASSOCIATED SPECIES:

E. leucoxylo ssp. *stephaniae* grows in small, but pure stands or occasionally in mixed communities. Where it grows as a mallee, any one of a number of mallee

species occurring across its range may be in the vicinity. Such species observed include *E. diversifolia* Bonpl., *E. rugosa* R. Br. ex Blakely, *E. leptophylla* F. Muell., *E. calycogona* Turcz., *E. incrassata* Labill., *E. anceps* (Maiden) Blakely, *E. dumosa* A. Cunn. ex Schauer, *E. wimmerensis* Rule and *E. arenacea* Marginson and Ladiges. In the Victorian Little Desert *E. aff. aromaphloia* Pryor and Willis may also be present. Its tree form is usually the dominant species in woodland communities and may be adjacent to or sometimes associated with a number of box species. These include *E. fasciculosa* F. Muell. and *E. porosa* F. Muell. ex Miq., in the western part of the distribution, and *E. aff. odorata* Behr ex Schlect., *E. largiflorens* F. Muell. and *E. microcarpa* Maiden, in the east.

ETYMOLOGY:

The subspecific name is dedicated to my daughter, Stephanie, who was a constant and enthusiastic companion during *Eucalyptus* field trips and who died suddenly and unexpectedly in October, 1986.

CONSERVATION STATUS:

Usually the populations of ssp. *stephaniae* are small in size and often well separated from each other. Despite this the number of populations is substantial and it is not a threatened taxon.

DISCUSSION:

Most herbarium specimens of ssp. *stephaniae* have been placed under ssp. *pruinosa*. Confusion with this subspecies is understandable as the two are not always separable when using dried adult materials, particularly if those of ssp. *pruinosa* are lacking surface wax and have been collected from small-leaved populations. A few collections, however, have been placed under ssp. *leucoxyton* and, most likely, this has occurred because they exhibited no surface wax.

Clearly the purpose of Boland was to deal with existing informal taxa otherwise he would not have overlooked the taxonomic integrity of ssp. *stephaniae*. He was obviously aware of its presence in Upper South-east South Australia and the Victorian Wimmera. However, his discussion was limited to just a single feature of the populations in the Victorian Big Desert between Murrayville and Yanac, that is, to the membranous pellicle which persists over the fruit's orifice after dehiscence.

Boomsma (1981) also gave attention to the desert populations but, unlike Boland, felt they were worthy of a subspecific status. However, for reasons of his own, he declined from providing a taxonomic treatment.

In the field ssp. *stephaniae* is readily separable from other subspecies when examined at close quarters, and its seedlings are also distinctive. From ssp. *pruinosa* it differs in being non-waxy in both adult and juvenile stages, its juvenile leaves are never connate — a feature which pervades most populations of ssp. *pruinosa* to varying degrees, its mature fruits regularly carry the persisting pellicle and it has a shorter period of juvenility.

E. leucoxyton ssp. *stephaniae* differs from the typical subspecies in having smaller adult and juvenile leaves, and fruits which are usually hemispherical or occasionally slightly globular-truncate, rather than elongated (cylindrical, sub-cylindrical or barrel-shaped), and which possess the persisting pellicle and shorter pedicels.

Fruit shape and size of ssp. *stephaniae* are similar to those of ssp. *connata* but the latter usually has longer pedicels and rarely the pellicle persisting across the orifice of the fruit. Further, its adult leaves are shorter but there is a small amount of overlap. The two differ most significantly in their juvenile leaves in that those of ssp. *stephaniae* are never connate.

Populations suggesting intermediacy between ssp. *stephaniae* and other subspecies have been observed. Such a case is in Western Victoria, in grazing

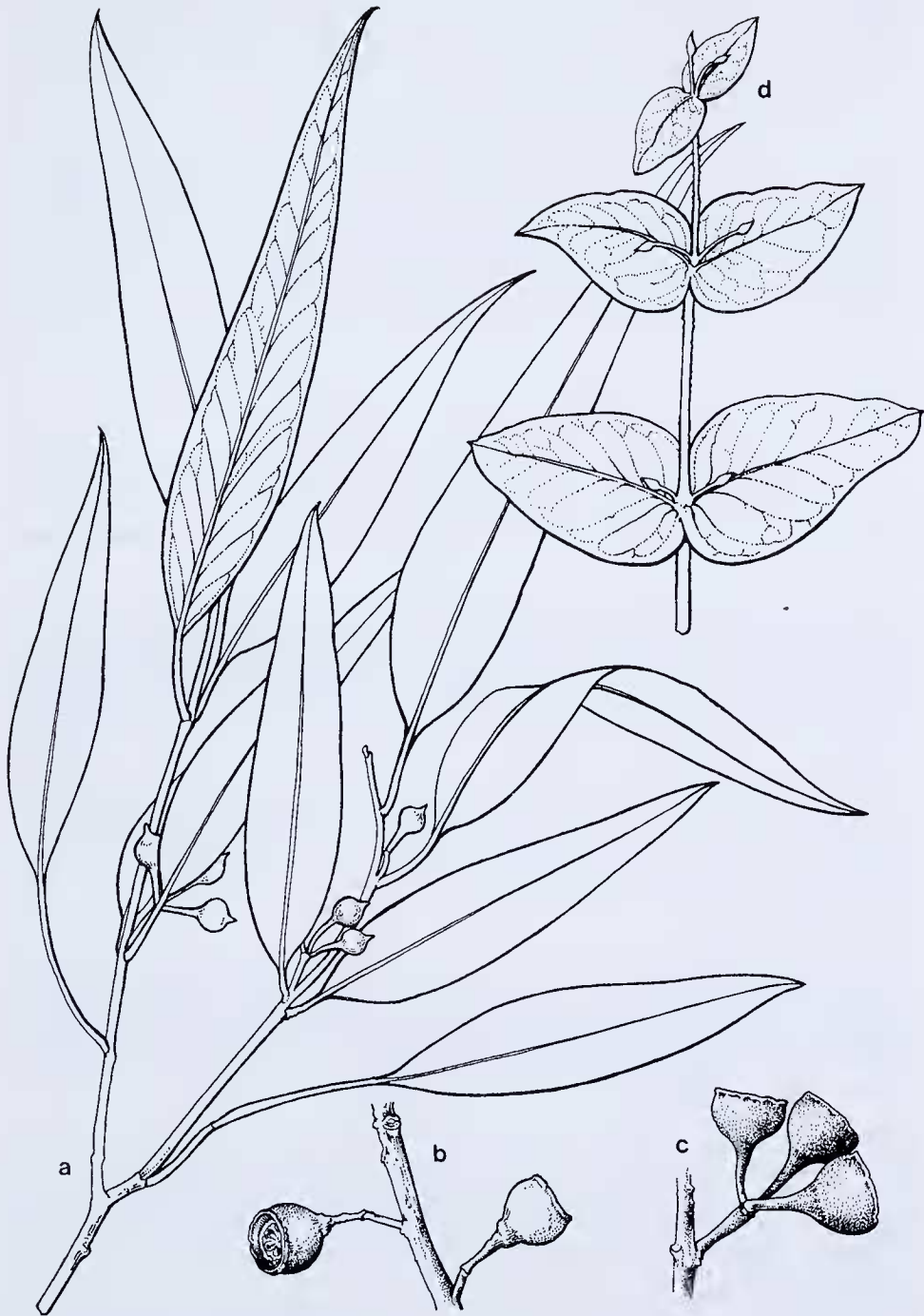


Fig. 2. *Eucalyptus leucoxyton* ssp. *connata* a — adult leaves and buds $\times 1$ (from Werribee Gorge population). b — fruits $\times 1$ (from Werribee Gorge population). c — fruits $\times 1$ (from Torquay population). d — juvenile leaves $\times 1$ (from Werribee Gorge population).

country to the south of the Little Desert. There, woodland trees, which occupy loamy soils, possess fruits featuring a range of shapes, sizes and pedicel lengths between ssp. *stephaniae* and ssp. *leucoxylon*. However, they are consistent with the latter in other features, particularly in juvenile and adult leaves and in this paper they are included with that subspecies.

Also, in parts of the Wimmera wheatlands, east of the known distribution of ssp. *stephaniae* and in North-central Victoria, populations are intermediate between it and ssp. *pruinosa*. These populations usually have waxy, non-connate juvenile leaves, are small-fruited and rarely exhibit adult surface wax. As well, the period of juvenility is not prolonged as in typical ssp. *pruinosa*. Some collections from North-central Victoria feature small, subcylindrical fruits which resemble those of ssp. *leucoxylon* and have been confused with that subspecies. These populations are regarded herein as ssp. *pruinosa* on the basis of their waxy juvenile leaves.

Eucalyptus leucoxylon* F. Muell. ssp. *connata* K. Rule ssp. *nov.

Arbor foliis juvenilibus ordinate connatis non glaucis, adultis ad 15 × 2.5 cm, alabastris globosis operculo rostrato et plerumque fructibus hemisphaericis in pedicellis longis. A subspecie typica foliis juvenilibus connatis et alabastris fructibusque brevioribus differt.

HOLOTYPE: 9.8 km W of Bacchus Marsh by road towards Werribee Gorge, 37°40'S, 144°21'E, 28.viii.1985, K. Rule (MEL).

Small to medium trees to 20 m. Bark smooth, white or light grey, mottled, often with brown, crusty fibrous bark on the lower trunk. Seedling leaves subsessile, ovate-elliptical, decussate for 3 or 4 pairs. Juvenile leaves sessile, opposite, green or blue-green, discolorous, non-waxy, cordate, or amplexicaul, becoming continually connate by the 8th to 15th pair; rarely non-connate; period of juvenility variable. Intranodal extensions usually occurring after the 20th pair. Intermediate leaves broad-lanceolate or ovate. Adult leaves olive-green to green, semi-lustrous, lanceolate or slightly falcate, to 14 × 2.5 cm. Buds globular. Ocular rows 4. Operculum rostrate. Fruits hemispherical or sometimes slightly subcylindrical, with tapered bases, to 8 × 11 mm. Pellicle rarely persisting. Locules (5-) 6 (-7). Valves to 2.5 mm deep. Pedicels as long as fruit or slightly longer. Peduncles to 11 mm. (Figure 2)

SPECIMENS EXAMINED:

Victoria — Werribee Gorge, 37°39'S, 144°17'E, 22.iv.1912, P.R.H. St John (MEL 573160); "Emu Bottom", on Jackson Creek (via Sunbury), 37°29'S, 144°35'E, 20.vi.1971, J.H. Willis (MEL 503339); 3 miles towards Steiglitz from Durdiwarrah, 37°53'S, 144°05'E, 6.ix.1966, E.J. Carrol (MEL); SW of Torquay, on Sunset Strip adjacent to the T-intersection with Bells Bvd, 38°21'S, 144°19'E, 14.v.1986, P. Carolan (MEL 684518); On the Ballan Rd approximately 100 m NW Anakie Junction, 37°53'S, 144°16'E, 26.iii.1987, K. Rule (MEL); Studley Park, Kew, 37°47'S, 145°02'E, 8.iv.1987, K. Rule (MEL); Greensborough, 37°41'S, 144°06'E, 15.v.1988, K. Rule (MEL)

DISTRIBUTION (Figure 2):

Populations of ssp. *connata* are at the south-eastern extremity of the range for the species. They are isolated from other subspecies by the Great Dividing Range in the north and north-west and the generally treeless basaltic plains of Western Victoria in the west. The nearest other subspecies is ssp. *pruinosa* in Central Victoria.

The main concentration of ssp. *connata* is in the Brisbane Ranges between Bacchus Marsh and Geelong where it is a relatively common woodland tree. It also occurs in isolated pockets near the coastal towns of Torquay and Anglesea, in the eastern and outer north-eastern suburbs of Melbourne and in the Sunbury area. It is never in abundance in these isolated populations, obviously due to clearing for farms and urban purposes.

The subspecies is strongly represented in the You Yang Ranges but this occurrence should be treated with caution as it appears to have been derived from an artificial seeding program of many decades ago.

E. leucoxyton ssp. *connata* grows in hilly terrain on soils derived from ancient silurian sandstone where it is usually found on well-drained slopes and ridges.

ASSOCIATED SPECIES:

Like other subspecies of *E. leucoxyton*, ssp. *connata* usually grows in pure stands but numerous other species are found in the vicinity. These include *E. melliadora* Cunn. ex Schauer, *E. sideroxyton* Cunn. ex Woolls ssp. *tricarpa* L. Johnson, *E. ovata* Labill., *E. viminalis* Labill. ssp. *viminalis*, *E. polyanthemos* Schauer, *E. macrorhyncha* F. Muell. ex Benth. and *E. obliqua* L'Herit. Above the Djerriwarrh Creek near Bacchus Marsh, the disjunct population of *E. behriana* F. Muell. is nearby. Of these, *E. melliadora* is the one with which it is most likely to be confused, but the two are easily separable using buds, fruits and juvenile leaves. *E. melliadora* also is a close relative and hybrids are not uncommon where they abut.

ETYMOLOGY:

The name is derived from the connate juvenile leaves which occur regularly in the subspecies.

CONSERVATION STATUS:

The numbers of ssp. *connata* are plentiful along the Brisbane Ranges, but elsewhere it has suffered heavy losses. Some populations are secure in protected reserves, such as the Brisbane Ranges National Park and Studley Park, but conservation authorities should act to preserve whatever they can of the remnant populations.

DISCUSSION:

In his 1978 study Boland included a population from near Meredith in the Brisbane Ranges about 50 km to the east of Melbourne. In his 1979 revision, he included it with other subcoastal populations in Western Victoria and regions adjacent to Adelaide under ssp. *leucoxyton*. However, the majority of his trial seedlings possessed connate juvenile leaves, a feature which also has been observed in the waxy subspecies but never in non-waxy populations west of the Brisbane Ranges. Subsequently, ssp. *leucoxyton* and ssp. *pruinosa* were erected on the basis of differences other than connation. Effectively, that created a dichotomy within the former — a strong expression of connation in the eastern populations and no connation in those in the west. His decision to suppress connation as a taxonomic character was a conservative one and even if this position is maintained the weight of other differences cannot be ignored.

E. leucoxyton ssp. *connata* also differs from the typical subspecies in having a longer period of juvenility. Seedling trials have shown that intranodal extensions rarely occur before the 20th node. Although not common, relatively mature trees have been observed still carrying intermediate leaves, a feature not uncommon in ssp. *pruinosa*. It is also an infrequent occurrence that some seedlings have a rapid period of juvenility. Such seedlings invariably have aberrantly narrow juvenile leaves and usually develop intranodal extensions by the 10th pair. Short petioles also appear at this stage or soon after. Even though these seedlings behave like those of typical ssp. *leucoxyton*, it is strongly suspected that they are of hybrid origin with *E. melliadora* as the other parent.

Whilst the adult leaves of ssp. *connata* are only marginally shorter than those of ssp. *leucoxyton*, there are, however, significant other differences between the two. The buds of ssp. *connata* are globular rather than elongated, as in ssp.

*leucoxylo*n, and its fruits regularly wider than long whilst those of ssp. *leucoxylo*n are longer than wide or less often approximately equal in length and width. The fruits of the ssp. *connata* also differ from those of ssp. *leucoxylo*n in possessing shallower valves, never deeper than 2.5 mm compared with a range between 2 mm and 4 mm. Further, they have never been observed with the sunken style base, a feature observed consistently in the fruits of South Australian populations of ssp. *leucoxylo*n.

From ssp. *pruinosa* the new subspecies is easily distinguished in being non-waxy. Also, the fruits are usually on longer pedicels and, with a few exceptions (those of the very waxy populations of South-east South Australia) are appreciably larger.

Differences with ssp. *stephaniae* have been discussed above.

In Victoria, across the northern fringes of the Grampians as far east as Ararat, the non-waxy populations possess a range of fruit shapes which are mostly elongated. A few fruits, however, are hemispherical and could be mistaken for those of ssp. *connata*. These cases are here regarded as aberrant forms of ssp. *leucoxylo*n.

KEY TO INFRASPECIFIC TAXA WITHIN *E. LEUCOXYLON*

1. Wax present at least on juvenile leaves ssp. *pruinosa*
1. Wax absent from all structures 2
2. Fruits with collar of lobes surrounding base of style; juvenile leaves petiolate, alternate ssp. *petiolaris*
2. Fruits without the collar of lobes; juvenile leaves sessile, opposite 3
3. Fruits longer than 1.2 cm and wider than 1.1 cm; adult leaves usually wider than 2.5 cm ssp. *megalocarpa*
3. Fruits smaller than 1.2 cm long and 1.1 cm wide; adult leaves less than 2.5 cm wide 4
4. Pedicel approximately half the length of the fruit, persisting pellicle present on mature fruits ssp. *stephaniae*
4. Pedicel equal to or longer than fruit, pellicle rarely persisting across orifice of mature fruit 5
5. Fruits hemispherical or sometimes subcylindrical, buds globular, juvenile leaves usually connate ssp. *connata*
5. Fruits subcylindrical, cylindrical or barrel-shaped, buds elongated, juvenile leaves never connate ssp. *leucoxylo*n

NOTES ON *E. LEUCOXYLON* F. MUELL.

The ancestral *E. leucoxylo*n's ability to adapt to a wide range of climates and soils has produced an equally diverse number of morphological variants, six of which are divergent enough to be recognised as infraspecific taxa. It is indisputable that it is an exceedingly complex species which has been a constant source of torment to taxonomists and observers over many years. Below several perspectives, which address some of the problems associated with its infraspecific taxonomy, are offered (Table 1).

CONNATION:

Taxonomists of the eucalypts have been conservative in dealing with connation in juvenile leaves and this suggests that it is either unimportant or its significance is not completely understood. Connate juvenile leaves occur only in

Table 1. Comparisons between the subspecies of *E. leucoxydon* F. Muell.

Characters	<i>ssp. leucoxydon</i>	<i>ssp. petiolaris</i>	<i>ssp. stephaniae</i>	<i>ssp. megalocarpa</i>	<i>ssp. pruinosa</i>	<i>ssp. connata</i>
Juvenile						
Leaves:						
Size	to 10.5 × 7 cm	to 7 × 5 cm	to 6.5 × 4.0 cm	to 8.5 × 7 cm	to 8 × 7.5 cm	to 7 × 6.5 cm
Shape	cordate to broad-lanceolate	ovate or broad-lanceolate	lanceolate, broad-lanceolate or ovate	cordate or broad-lanceolate	cordate, occasionally broad-lanceolate or broad-ovate	cordate or rarely broad-lanceolate
Surface wax	absent	absent	absent	absent	present	absent
Basal features	connation absent, amplexicaul and/or cordate bases usually present	connation absent, rounded	connation absent, rounded, rarely cordate and never amplexicaul bases	connation absent, rounded, cordate, or occasionally amplexicaul bases	continual connation present (less frequent in South Australian populations), mixed with rounded, cordate and/or amplexicaul bases	Continual connation mixed with amplexicaul, cordate and/or rounded bases
Petioles	absent	present	absent	absent	absent	absent
Ontogeny:						
	lanceolate pairs and intranodal extensions present by the 15th pair	intranodal extensions occur by 6th pair	intranodal extensions between 9th and 20th pairs	juvility variable but not as rapid as <i>ssp. leucoxydon</i> or <i>ssp. stephaniae</i> . Intranodal extensions usually occurring after 2.5th pair	sessile, opposite juvenile pairs persisting indefinitely. Some mature trees may retain pre-adult leaves	variable, but intranodal extensions rarely occurring before the 20th node. Intermediate leaves sometimes retained in relatively mature trees
Adult Leaves:						
Size	to 18.5 × 2.5 cm	to 15 × 2.5 cm	to 12 × 2 cm	to 16 × 3.5 cm	highly variable, to 20 × 2.5 cm	to 14 × 2.5 cm
Petiole length	to 2.5 cm	to 2.0 cm	to 2.0 cm	to 2.5 cm	to 2.5 cm	to 2.0 cm
Buds:						
Shape	ovoid	ovoid, cylindrical or clavate	globular	ovoid	globular	globular
Ovular Rows	4 to 6	6 to 8	4	4 to 6	usually 4	4 or rarely more
Operculum:						
Shape	rostrate to beaked	conical to beaked	obtuse-conical to rostrate	conical, rostrate or beaked	conical to short rostrate	rostrate
Ribbing	absent	light	absent	absent	absent	absent

Characters	<i>ssp. leucoxydon</i>	<i>ssp. petiolaris</i>	<i>ssp. stephaniae</i>	<i>ssp. megalocarpa</i>	<i>ssp. pruinosa</i>	<i>ssp. connata</i>
Fruits:						
Size	to 12 × 10 mm	to 16 × 14 mm	to 8 × 11 mm	to 17 × 14 mm	to 9 × 14 mm	to 8 × 11 mm
Shape	subcylindrical, cylindrical or barrel-shaped	campanulate, subcylindrical or subcylindrical to 4 mm	hemispherical or slightly globular-truncate to 2 mm	globular-truncate, subcylindrical or barrel-shaped to 6 mm	hemispherical or rarely subcylindrical to 2 mm	hemispherical or sometimes subcylindrical to 2.5 mm
Valve Depth	occasionally only light	light to conspicuous	absent	only very light, if present	absent	absent
Ribbing	5 (-6)	5 or 6	6 (-7)	5 (-6)	6 (-7)	(5-) 6 (-7)
Locules	never persisting	absent	persisting	never persisting	rarely present	rarely present
Pellicle	present in South Australian populations	absent	absent	absent	absent	absent
sunken style base	absent	present	absent	absent	absent	absent
Lobed collar (surrounding style base)						
Pedicel length	equal to length of fruit or longer, to 15 mm	to 18 mm	less than fruit length	to 20 mm	usually shorter than fruit	to 12 mm
Peduncle length:	rarely shorter than pedicel, to 15 mm	to 20 mm	to 11 mm	to 20 mm	to 11 mm	to 12 mm
Adult Wax:	absent	absent	absent	absent	present but level is variable	absent
Habit:	small to medium trees to 25 m	robust mallees or small trees to 12 m	small mallees, robust mallees or small trees to 15 m	mallees or small trees to 15 m	mallees or small to medium trees to 20 m	small to medium trees to 20 m

a few species of *Eucalyptus* and the feature has been used as a taxonomic character in such cases, but only in support of other characters in separating pairs of related taxa. It is doubtful, for example, whether *E. uncinata* Turcz. and *E. discreta* Brooker could stand apart as separate species just on the presence or absence of connate juvenile leaves. The circumstances are similar in the case of *E. gamophylla* F. Muell. and *E. odontocarpa* F. Muell. Clearly the condition is an observable character, as are surface wax, a particular fruit shape, a collar of lobes surrounding the base of the style and so on. Whilst the cases cited above are concerned with differences between species, the focus of this paper is on infraspecific taxonomy and, in that context, connation becomes a more potent character.

Connation in ssp. *pruinosa* presents taxonomic difficulties, particularly as it exists across the total distribution. In Central Victoria from Euroa to Stawell, non-connate seedlings are the exception, but in populations to the west, including the type locality (the Barossa Valley), it is the reverse. Clearly there is an east-west continuum of connation which, together with the presence of surface wax and aspects of fruit morphology, contributes to linking an indeterminate number of populations into a taxonomic unit. Until new evidence is forthcoming, this position remains justifiable.

FRUIT SIZE AND SHAPE:

Fruit sizes within *E. leucoxyton* have been referred to as large, medium and small. Boland used the combined length of fruit and pedicel to distinguish between his subspecies; less than 1.5 cm (ssp. *pruinosa*), less than 2.5 cm (ssp. *leucoxyton*) and 2.5 cm or longer (ssp. *megalocarpa*). This is a reasonably reliable means of identification but there are some exceptions. For example, there are populations of ssp. *leucoxyton* on the Fleurieu Peninsula and Kangaroo Island, which have some oversized fruits on relatively long pedicels, and others across the northern fringes of the Grampians, where medium-sized fruits sometimes have markedly long pedicels, and in small fruits of ssp. *connata*, this is a reasonably reliable means of identification. Further, throughout populations of ssp. *connata*, the combined length of fruit and pedicel is sometimes less than the lower limit of the medium-sized category. However, ssp. *stephaniae*'s total length rarely reaches 1.5 cm and this compatibility with Boland's prescription for small fruits appears to be diagnostically useful.

With regard to fruit shapes, each subspecies can overlap with other subspecies. It would therefore be imprudent for the observer to place too much value on this aspect of morphology. To illustrate this point, although the usual shape of ssp. *connata*'s fruits is hemispherical, which contrasts well with the elongated ones of ssp. *leucoxyton*, those that are subcylindrical can lead to confusion between the two subspecies.

The convergence of fruit of ssp. *stephaniae* and ssp. *pruinosa*, where the usual shape is hemispherical, is also a source of difficulty. This similarity has contributed to the confusion between these two. Further, the shapes of these subspecies invite confusion with ssp. *connata*. Yet again, other characters are required to aid identification.

THE SUNKEN STYLE BASE:

The sunken style base can be observed in a small pit, which is up to 2 mm deep, in the well of the fruit after the withered style has become detached. Its presence is lost once dehiscence occurs. Occurrences in *E. leucoxyton* fruits have been observed only in South Australian populations of ssp. *leucoxyton* and in the cultivar, "var. *rosea*". The condition has been given little attention as a taxonomic character, although Boland noted its presence in the flowers of many populations of the species in his 1978 study. However, observations suggest that its manifestation in fruits is limited.

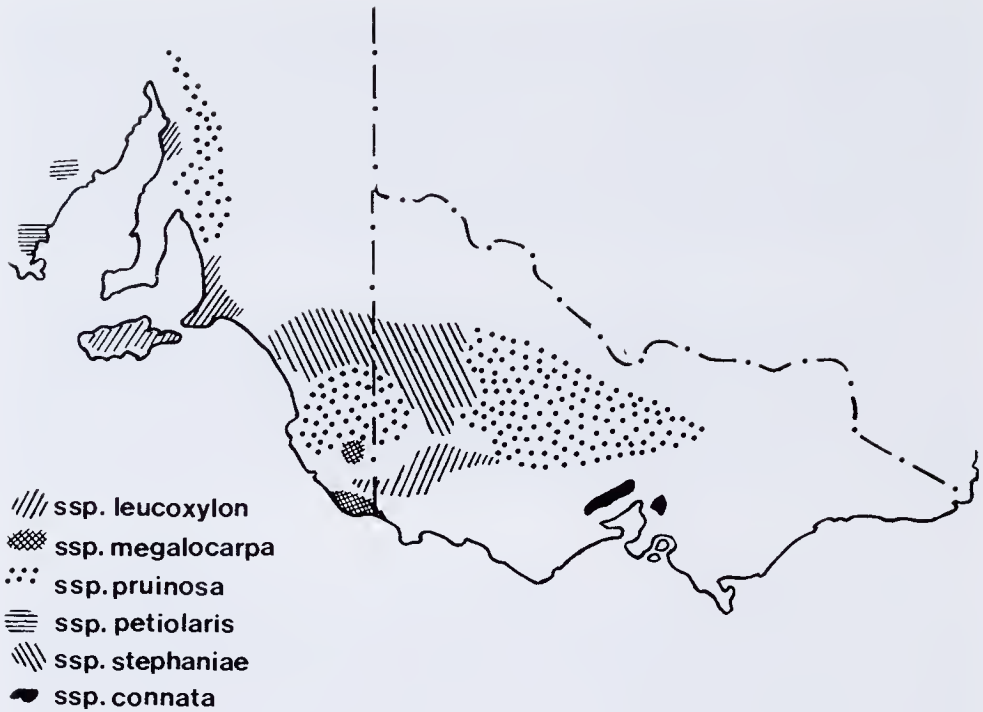


Fig. 3. Distribution map of *Eucalyptus leucoxylon* subspecies.

The sunken style base could prove a useful taxonomic tool for distinguishing between *ssp. leucoxylon* and other non-waxy subspecies where there are similarities in fruit sizes. Such a case exists on the Fleurieu Peninsula and Kangaroo Island where the presence of *ssp. megalocarpa* has been disputed by some authorities. Most certainly it has been considered as a taxonomic criterion in the segregation of *ssp. connata* from the typical subspecies, but only at a minor level. The condition has not been observed in other Victorian non-waxy populations adjacent to the Grampians and in the south-west of the state but they have been retained within *ssp. leucoxylon* on the grounds that their adult and juvenile features are consistent with that subspecies.

THE PELLICLE:

Both Boland (1978) and Boomsma (1981) implied that only the desert populations of *E. leucoxylon* possessed the pellicle. To the contrary, field observations have revealed a few cases of its presence in both *ssp. pruinosa* and *ssp. connata*. Of these, it tended to be more common in the former.

Obviously the phenomenon of the persisting pellicle needs clarification. In the fruits of all subspecies of *E. leucoxylon*, except *ssp. petiolaris*, the ovary roof is covered by a thin layer of pale tissue which is the precursor of the pellicle. Whether or not it matures and remains wholly or partly intact after dehiscence appears to be related to the fruit's age and its structure. In all cases observed, both in *ssp. stephaniae* and other subspecies, the fruits had reached maturity and had relatively shallow valves and broad orifices.

Boland also suggested that the pellicle was a mechanism for retaining fertile seeds in adverse climatic conditions. Another attribute of *ssp. stephaniae* is its ability to retain large crops of fruits over several seasons which permits not only the retention of seeds, but the development of the pellicle. This combination

appears to be one of the strategies which the subspecies has developed to meet its reproductive needs.

ADULT LEAF SIZES:

The traditional perspective of leaf sizes within *E. leucoxyton* has been that ssp. *megalocarpa* has the largest and ssp. *pruinosa* the smallest, with ssp. *leucoxyton* somewhere in between. Most certainly ssp. *megalocarpa* has the broadest, but when the dimension of length is considered nothing is clear-cut. In fact, each subspecies shows considerable variation and at best leaf lengths are unreliable characters. Of all the subspecies, only the lengths of ssp. *stephaniae* offer any value as taxonomic aids and that is because they are generally the shortest. Rarely do its leaves reach 12 cm and lengths of less than 10 cm are not uncommon. Even then there is overlap with other subspecies. For example, some populations of ssp. *pruinosa*, particularly those of the Barossa Valley and the Southern Flinders Ranges, have adult leaves similar in length to those of ssp. *stephaniae*. By contrast, those of other populations of ssp. *pruinosa* in Central Victoria can be the longest within the species. Field studies of numerous populations in this region have found individual trees with leaves nearly 20 cm long. Subspecies *leucoxyton* also has a wide range of adult leaf lengths. Leaves in some populations could be classed as markedly long. In the Mt Lofty Ranges and on the Fleurieu Peninsula individual trees with longest leaves exceeding 16 cm were not uncommon. Across the northern fringes of the Grampians even longer leaves were observed. However, like ssp. *pruinosa*, the lower limit of the range in ssp. *leucoxyton* overlaps with ssp. *stephaniae* and there is only a very limited scope for using leaf lengths to distinguish between the two subspecies. The ranges of lengths of ssp. *megalocarpa*, ssp. *petiolaris* and ssp. *connata* fall within those of both of ssp. *pruinosa* and ssp. *leucoxyton* and also overlap with ssp. *stephaniae*.

SURFACE WAX:

Some specimens of ssp. *pruinosa* have been identified as ssp. *leucoxyton* because they exhibit no adult wax. This condition is not uncommon in populations in the Barossa Valley and northwards. In fact, adult surface wax in these populations is regularly only light. By contrast, in populations of the subspecies in South-east South Australia and Central Victoria, the other main centres of distribution, surface wax is usually heavy and there is little scope for confusion with other subspecies. Despite the variability in adult surface wax, all normal seedlings of the subspecies are uniformly waxy.

DISTRIBUTION PATTERNS:

The notion that infraspecific taxa within *E. leucoxyton* correspond with coastal, subcoastal and inland climates to some extent is an oversimplification. Most of the subspecies have populations on the extremities of their distributions or outliers which disobey these prescriptions. For example, ssp. *megalocarpa*, which is thought of as being coastal, has inland populations in South-east South Australia, and ssp. *leucoxyton*, previously considered as sub-coastal, has coastal populations on Kangaroo Island and the Fleurieu Peninsula and inland populations in Western Victoria. Further, ssp. *connata* is both subcoastal and coastal, whilst both ssp. *pruinosa* and ssp. *stephaniae*, which are essentially inland forms, have populations in close proximity to the coast in South-east South Australia.

CULTIVARS:

Of considerable interest to the infraspecific taxonomy of *E. leucoxyton* is the horticulturally exploited form known as var. "rosea" or less often var. "macrocarpa rosea" or "dwarf". Whilst it breeds true, except for flower color, and is morphologically distinct, its origins are obscure and it can have no taxonomic

status. It is one of the most widely planted ornamental eucalypts in Victoria and South Australia and its features dominate many enthusiasts' understanding of the species. Some observers have confused it with ssp. *megalocarpa* and others have suggested that it has been derived from ssp. *petiolaris*. However, its slender leaves of less than 10 cm, relatively large, cylindrical fruits with the sunken style base and alternate, subpetiolate juvenile leaves are distinctive. If a parent population does exist and could be located, the form would be entitled to a subspecific status.

ABERRATIONS:

The incidence of aberrant seedlings in *E. leucoxylon* has been discussed above where it was suggested that they were of hybrid origin. This phenomenon has been observed in many of the populations sampled for seedling trials and was a feature which occurred in varying frequencies in seedlings of most provenances of both ssp. *connata* and ssp. *pruinosa*.

Seven-budded inflorescences also occur in small numbers in many populations within the species. Boland noted this and made particular reference to the Jeparit area where he suggested there may have been an influence from *E. largiflorens*. Of the many occurrences throughout the species, the feature is most common in the populations of the western extremity of ssp. *stephaniae*. It is also suspected that these cases may have originated from hybrids, with *E. fasciculosa*, which is invariably in the vicinity or even an associate, as the other parent. Where the feature occurs in populations of ssp. *connata*, *E. melliodora* is usually an associated species. In fact, hybrids with that species are not uncommon.

FUTURE STUDIES:

The Boland study of 1978 and the contributions of Boomsma (1981) have opened the door to a greater understanding of *E. leucoxylon*. The study reported in this paper should be regarded as an extension of those works. Even with the erection of the two new subspecies it would be naive to assume that the species has been fully treated. Its ability to adapt to a wide range of soils and climates suggests that other previously unnoticed forms might exist.

In the meantime, investigations of the known taxa are continuing and it is anticipated that a greater understanding of the infraspecific relationships within the species will be reached. An important aspect of this ongoing process is the reassessment of the taxonomic disposition of the markedly divergent ssp. *petiolaris*.

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